

Literature Study on the Influence of Arduino Microcontroller Trainer Media on Creative Thinking Level and Student Learning Outcomes in Microcontroller Learning

Karno Setyo Budi, Supari Muslim, Agus Budi Santosa

Vocational Technology Education

Universitas Negeri Surabaya

Surabaya, Indonesia

karnobudi16070895001@mhs.unesa.ac.id

Abstract—The background of this research is that the microcontroller trainer media in schools still cannot significantly improve students' creative thinking skills. The main reason is because the media trainer used is still relatively complicated, so it is difficult to understand by students. This study aims to determine: (1) the characteristics of the Arduino microcontroller media trainer; (2) the influence of arduino microcontroller trainer media on students' creative thinking skills; and (3) the influence of Arduino microcontroller trainer media on student learning outcomes. This study uses literature study method to a number of related references, including a number of national and international journals, so that the results of the research are as follows: (1) the Arduino microcontroller trainer media has an attractive appearance character and is easy to use by students; (2) the use of Arduino trainer media can improve students' creative thinking skills; and (3) the use of Arduino trainer media can improve student learning outcomes. The suggestion in this study is that learning in the laboratory must be a proper learning tool, each teacher must follow the development of learning.

Keywords—*Arduino trainer media; creative thinking levels; learning outcomes; microcontroller subjects*

I. INTRODUCTION

Microcontroller lesson material is needed in order to improve students' readiness to work. Because almost all equipment in the industry has used automation in the production process. Meanwhile, to study microcontroller material better, microcontroller trainer media is needed [1]. The fact shows that the microcontroller trainer media in schools, in general have not been able to provide understanding to students about microcontroller material and have not been able to improve students' creative thinking skills. Because the AVR microcontroller trainer media used in schools is still relatively complicated, making it difficult to understand by students. Based on research Candelas students are very difficult to understand microcontroller learning because learning media is less attractive [2]. Agree with the arguments above Kriswandono that existing learning media are not yet equipped with job sheets [3].

In relation to government efforts to improve the quality of the Middle School Education, the President of the Republic of Indonesia issued Presidential Instruction No.9 of 2016. The Presidential Instruction of the Republic of Indonesia contains Revitalization of Vocational Schools in order to improve the quality and competitiveness of Indonesian human resources, including through contextual learning about material taught by teachers, such as the use of instructional media in the form of trainers that can foster creativity the students [4].

From the introduction above, this study aims to determine: (1) the characteristics of the Arduino microcontroller media trainer; (2) the influence of arduino microcontroller trainer media on students' creative thinking skills; and (3) the influence of Arduino microcontroller trainer media on student learning outcomes.

A. Arduino Based Microcontroller Media Trainer

Media trainers are needed in the learning process, especially during practical lessons [5]. The media trainer referred to here is a teaching aid that can be absorbed by the eyes and ears with the aim of helping the teacher to make the learning process more effective and efficient [6]. The microcontroller trainer media used in this research is based on Arduino. Arduino is defined as an open source electronic platform, based on software and hardware that is flexible and easy to use [7]. Thus it can be concluded that the Arduino-based microcontroller trainer media is an Arduino-based microcontroller props that can help students understand the material in creating creative work.

B. Students' Creative Thinking Ability

According Suparji, that the use of Arduino microcontroller trainers can improve students' creative thinking abilities that have characteristics of fluency, flexibility, and novelty [8]. Creative thinking is also interpreted as a mental activity that is used by someone to build new ideas or ideas fluently and fallibility [9-11]. By using media trainer students will have the ability to make their experiments work as planned, and make

their work become better, more meaningful, and more beautiful [11].

Thus it can be stated that the use of Arduino microcontroller trainers can improve the ability to think creatively for students, so that they are able to give birth to something new, whether in the form of ideas or real work that is relatively different from what was previously available.

C. Student Learning Outcomes

Besides being able to improve the ability to think creatively, that the use of Arduino trainer media can influence student learning outcomes.

Learning outcomes can be explained by understanding the two words that shape it, namely results and learning. The definition of product results refers to an acquisition due to an activity or process that results in a functional change in input. Production results are obtained due to the activities of converting materials into finished goods. The same applies to limiting the terms of learning outcomes [12].

Learning outcomes are changes in student behavior due to learning. Behavioral change is caused because he achieved mastery over a number of materials given in the teaching and learning process. The achievement is based on the stated teaching objectives. The results can be in the form of changes in cognitive aspects, or psychomotor [12].

Student learning outcomes include three domains, namely affective, cognitive, and psychomotor domains [12]. Affective domain learning outcomes are changes in behavioral abilities, whereas cognitive domains are changes in thinking abilities, and psychomotor domains provide changes in learning outcomes in the form of skills [13].

From the opinions of some experts above it can be concluded that learning outcomes are the acquisition of student learning processes and the occurrence of changes in student behavior due to learning in accordance with the purpose of teaching. This change in behavior is caused because he achieved control over a number of materials given in the teaching and learning process. Changes that result in people changing their attitudes and behavior.

D. Microcontroller Subjects

The subjects used in this study are microcontroller subjects. Microcontroller is a microprocessor that is devoted to instrumentation and control [14]. Inside the microcontroller consists of CPU, ROM, RWM, parallel I / O, series I / O, counter-timer, and clock circuit in a single chip. The microcontroller was first introduced by Texas Instruments with the TMS 1000 series in 1974 which was the first 4-bit microcontroller [15].

The microcontroller diagram block is shown in Figure 1 below.

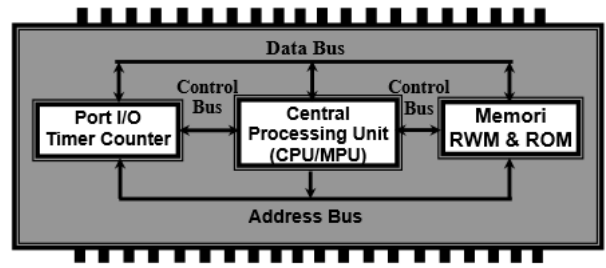


Fig. 1. Microcontroller diagram [14].

Microcontroller consists of several parts, namely: (1) I / O ports that function to provide input from the input port and provide output commands from the output port; (2) CPU that functions to process programs from input that will be discussed on output; and (3) Memory that functions to store program memory permanently and temporarily [14].

Microcontroller subjects really need teaching aids to simulate learning activities, so that students not only learn microcontroller material in theory, but also practice it. The props used in this study are Arduino-based microcontrollers.

Arduino is an open-source electronic based pension system that is flexible and easy to use both in terms of hardware and software. In addition, the main strength of Arduino is the large number of users, so there are a large number of program code libraries and supporting modules. This makes it easy for students to get to know the world of microcontrollers [3].

The advantages of Arduino compared to other microcontroller hardware platforms are: (1) IDE Arduino is a multiplatform, which can run on various operating systems, such as Windows, Macintosh and Linux; (2) The Arduino IDE is made based on a simple IDE Processing so it is easy to use; (3) Arduino programming using a cable that is connected to a USB port instead of a serial port. This feature is useful because many computers today do not have serial ports; (4) Arduino is an open source hardware and software, so readers can download software and images of the Arduino circuit without having to pay to the Arduino maker [16].

The Arduino board shape looks like the following Figure 2.



Fig. 2. Arduino board.

Arduino Uno Board (Figure 2) has 6 Analog Inputs, 13 Digital Outputs, Arduino source voltage of 5 Volts DC, and USB downloader which has become one with Arduino board.

Arduino-based microcontroller trainer media is very suitable to be applied to class X microcontrollers on Audio Video Engineering Skills Competencies at Vocational High Schools.

II. RESEARCH METHODS

This study uses a literature review method on a number of related references, including a number of national and international journals to obtain the desired research results.

The purpose of the literature study is to collect scientific information data in the form of theories or approaches that have been developed and have been documented in the form of books, journals, manuscripts, historical recordings, other documents contained in the library to obtain conclusions from various sources [17].

The steps of reviewing the literature in this study are as follows: (1) identifying the key research topics to find related material, references and library materials; (2) reading abstracts of relevant research reports obtained from national journals, international journals, books and proceedings; (3) record the results of the reading by making a complete literature map of the sequence and relevance of the research topics and bibliographic references; (4) summarizing the literature in full based on literature maps, in accordance with the sequence and relevance of the topics of each variable; (5) making literature studies by arranging thematically based on important theories and concepts related to research topics and variables; (6) at the end of the literature review, presented a general view of the topic of research conducted based on the existing literature, and explained the originality and importance of the research topics that had been carried out compared to the existing literature. [17].

III. RESULT AND DISCUSSIONS

A. Characteristics of Arduino-Based Microcontroller Trainer Media

The media trainer that uses the basic material of the Arduino Uno microcontroller which is designed to be a visual aids (Arduino Uno microcontroller trainer), is used to channel learning material about controlling input and output ports to turn on LEDs, Seven Segment and LCD matrices that are packaged into a project, so that it can stimulate attention, interests, thoughts, feelings of students and the level of creative thinking of students in learning activities to achieve learning goals. Syahwil [13] stated that the Arduino is an electronic kit or an open source electronic circuit board in which there is a main component, namely a microcontroller chips with an AVR type from the Atmel Company.

The advantages of Arduino are as follows: (1) relatively cheap prices [18]; (2) Arduino products provide input and output components in support of students experimenting with Arduino; (3) the availability of many references on the internet about the Arduino application [19]; (3) Arduino is easily

available [18]; (4) the software is open source so it's free without charge; (5) in the Arduino software there is a library containing examples of program languages for the Arduino application so that students can develop their own projects that will be made as desired; (6) Arduino software is integrated with Proteus software so that students without having Arduino can still use Arduino simulation using Proteus so that students do not need to worry about failing to experiment due to short circuit or incorrect installation; and (7) there are several Arduino without needing an additional board for the USB downloader, because the Arduino downloader board has become a more practical module.

Thus it can be concluded that the arduino microcontroller trainer media has several characteristics, namely: (1) board display that attracts students' attention [20] [21], (2) easy to use [22], (3) relatively cheap price, (4) easy to obtain [18], (5) has many references on the internet [19], (6) can be developed according to research needs, (7) can be used with STEM methods in classroom learning [23], and (8) get a positive response from students.

The Arduino-based microcontroller media trainer form is shown in Figure 3 below.



Fig. 3. Arduino based microcontroller trainer media.

The Arduino-Based Microcontroller Media trainer (Figure 3) has 6 Output a component such as: (1) LCD Matrix; (2) Seven Segment Common Anodes, (3) Seven Segment Common Cathode, (4) Light Emitting Diodes, (5) DC Motors, and (6) Buzzers. While the connection using the Push Button is 4 Push Button.

B. Utilization of Arduino-Based Microcontroller Media Trainer can Improve Students' Creative Thinking Ability

According to Filsaime creative thinking is a process of thinking that has characteristics of fluency, flexibility, authenticity or originality, Starko and Fisher also add another component of creative thinking, namely elaboration or adding ideas to make it clearer [9]. In line with the idea, Diptoadi, Zainuddin, Ismanoe, Waras, and Prastiti suggested that students will basically learn according to their learning style, and each learning style influences the thinking process and learning outcomes [10]. Creative thinking is defined as a mental activity that is used by a person to develop new ideas or ideas fluently and fallibility [9]. Suparji reinforces the above

idea that the component of creative thinking consists of fluency, flexibility, and novelty [8]. Learning that is focused on students' ideas and students' interests, and with students' daily experiences will enhance student learning [9].

Creativity-based learning is needed in education [23]. By using Arduino microcontroller trainer media can influence students' creative thinking skills, because by using Arduino media students can produce creative, interactive, openness of processes and collaboration [24]. Using the Arduino board during microcontroller learning, students can do various experiments, because the Arduino board is supported by the availability of input and output a board that can be used on Arduino boards, so that students can use their creative thinking skills during microcontroller learning using Arduino boards [15].

From the discussion of several studies as described above, microcontroller learning requires the Arduino Uno media trainer to improve students' creative thinking skills.

C. Utilization of Arduino Based Microcontroller Media Trainer can Improve Student Learning Outcomes

Arduino microcontroller trainer media can influence student learning outcomes, because students can easily learn subject matter using the Arduino trainer [25]. The results of this study are supported by the results of Liao's research [26] which concluded that with Arduino, students can learn to experiment on their own to get the understanding that students want. The results of Liao's research are supported by the results of Candelas' research [27] that the use of Arduino trainers can improve student learning outcomes, including psychomotor learning outcomes, according to Gronlund which can be assessed from two references, namely the reference procedure and reference results [28]. Assessment of learning outcomes in the psychomotor domain of procedure procedures is an assessment of students' abilities in matters: (1) preparing a detailed plan for a project; (2) determine the amount of material needed; (3) choosing appropriate equipment; (4) follow the correct procedures for each implementation; (5) using tools properly and skillfully; (6) using unnecessary scattering materials; and (7) perfecting the work in a timely manner. Assessment of psychomotor domain competencies of students with results is an assessment of the quality of student work which includes: (1) whether the product is good and perfect; (2) whether the distribution is in accordance with the original plan; (3) whether the final result is in accordance with the specifications; and (4) whether the circuits are running well. So based on this research, when learning students' psychomotor value practicum based on procedures and results references. By using Arduino trainer media can improve the learning outcomes of students' psychomotor domains, this is because at the time of practicum students have received clear instructions on work procedures when doing lab work on microcontroller material [21].

From some research results and some opinions of experts as explained above, that by utilizing the Arduino media trainer, that student learning outcomes can increase, because students can practice more freely without having to be accompanied by a teacher, because a lot of tutorials on the internet about

making projects using Arduino. More than that, the Arduino media trainer is easier to use than other microcontrollers, such as AVR.

IV. CONCLUSION

Based on a review of various literatures and relevant research results as described above, it can be concluded that: (1) the Arduino microcontroller trainer media has several characters, namely: the board display that attracts students' attention, easy to use, relatively cheap prices, easy to obtain, has a lot of references on the internet, can be developed in accordance with research needs, can be used with the STEM method in classroom learning and get a positive response from students; (2) utilization of arduino-based microcontroller trainer media can improve students' creative thinking skills in several ways as follows: students can do simple experiments by utilizing the library menu on Arduino software, so students can improvise the program language as desired, students can simulate the project circuit scheme using Arduino in proteus software, so that students do not need to worry about damaging the component if it is wrong in the installation, so that the level of creative thinking ability will work optimally during the simulation; and students can combine several inputs and outputs provided by the Arduino manufacturer to create; (3) with the use of Arduino trainer media, student learning outcomes can increase, because students can practice independently without having to be accompanied by a teacher, because students can see tutorials on the internet about applications on Arduino; and (4) arduino media trainer is easier to use than other microcontrollers such as AVR, for example.

The suggestion in this study is that learning in the laboratory must be a proper learning tool, each teacher must follow the development of learning.

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